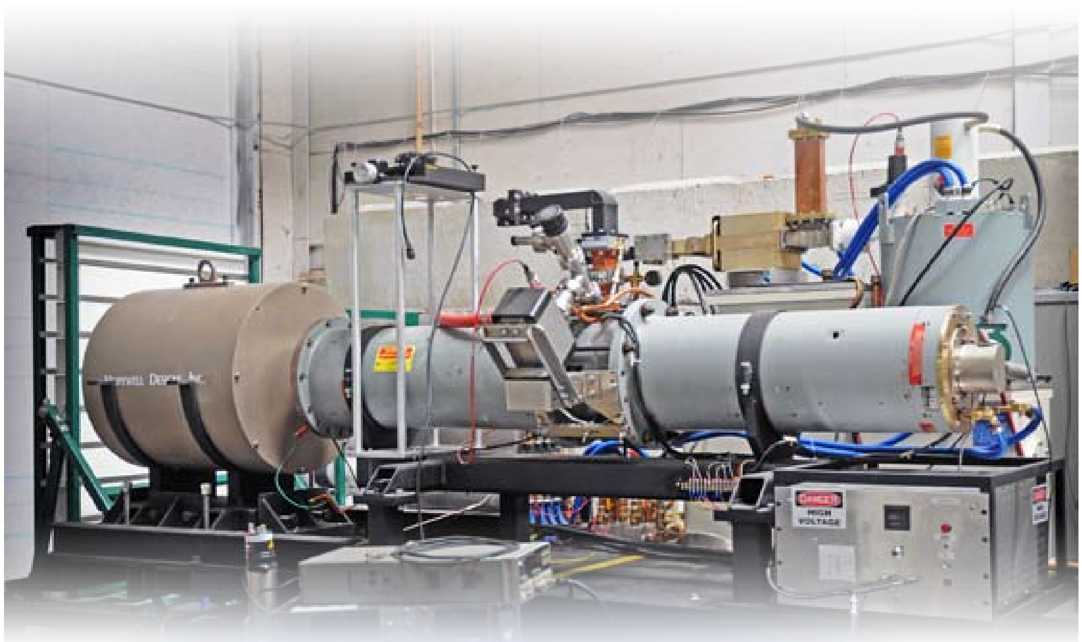

The PITAS system is capable of detecting shielded nuclear materials in cargo containers at distances up to 200 meters.

Photonuclear Inspection and Threat Assessment System

An advanced cargo-screening technology for detecting illicit radiological materials

In the United States, tens of thousands of cargo containers – most the size of a rail car – enter the country every day through one of 93 maritime ports. Each container holds a surplus of products ranging from clothing to plasma televisions and medical equipment bound for places like superstores and hospitals.

But since Sept. 11, 2001, concerns have been raised about how best to prevent dangerous materials or contraband items from being smuggled into the country alongside the millions of imported goods. In particularly, homeland security and law enforcement professionals are most concerned about the potential for illicit radiological materials to make their way into the country through these shipping ports.

The traditional counterproliferaton approach has been to develop and implement a massive cargo-screening program with the lofty goal of inspecting every cargo container being off-loaded on the dock. But this approach has been problematic, mainly due to the limited technical advances in screening technology, and the time delay to scan each container.

In addition, new concerns about the worldwide availability of nuclear materials and technology, combined with a rise in global terrorist operations, have likely increased the risk of a domestic nuclear attack. Nonproliferation experts claim that what is needed is a greater emphasis on detecting nuclear materials before they enter or near the 95,000-mile maritime border of the United States.

INL's Solution

To confront this growing challenge, scientists and engineers at the U.S. Department of Energy's Idaho National

Continued next page

The Energy of Innovation

Idaho National Laboratory

Foreign and domestic shipping ports will have increased protection from the PITAS system.

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Laboratory are perfecting a technology that has the capabilities to accurately scan cargo containers for smuggled nuclear materials at long standoff distances.

Known as the Photonuclear Inspection and Threat Assessment System (PITAS), this non-intrusive technology employs a transportable high-energy linear electron accelerator to channel high-velocity atomic photons into a precise invisible beam that inspects the cargo containers. If nuclear materials are present, this process instantly induces fission, or divisions, in the atomic nucleus of the material.

The PITAS system uses an array of neutron and gamma detectors to determine the presence of nuclear materials.

Using a series of patented cylindrical detectors and a standard laptop computer, time-dependant gamma and neutron signatures emitting from the source are analyzed for illicit radiological characteristics. And since the PITAS technology uses an active interrogation process, it can detect material that has been covertly shielded, radiological dangers such as plutonium, uranium or thorium can be distinguished from simple medical or household items, which often yield false positive alarms and time delays in competing technologies.

In addition, operational factors such as material quantity distance to source and the accelerator's electron beam energy yields a detection time ranging from several seconds to two minutes. Any resulting short-lived radioactivity around the inspected object is either immeasurable or, due to the very short time period for inspection, has no detrimental effects. The PITAS system is operated using remote Ethernet transmission, and powered by a single gas generator which allows it to be operated in nearly any environment.

Parts of the PITAS

The PITAS technology consists of four main components including the waveguide, klystron, collimator and the targeting platform. The complete PITAS technology is the simultaneous operation of these components working together in harmony

First, the waveguide creates a burst of electron energy and injects them into a central vacuum tube that runs the entire length of the PITAS system. As the electrons are being injected into the waveguide, a klystron generates a finely-tuned radiofrequency that meets the electrons. The radiofrequencies help direct the electrons into the collimator and accelerate them to a high rate of speed necessary for nuclear materials inspection.

Once the electrons are inside the collimator they are converted into high-energy x-rays. Excess neutrons and absorbed by the collimator which results in a bremsstrahlung radiation process similar to a dental x-ray. Then, the collimator forces the energy beam through a small opening in the direction of the cargo container.

The complete PITAS system includes a linear accelerator, collimator, hydraulic platform and a series of neutron and gamma detectors all operated by remote control

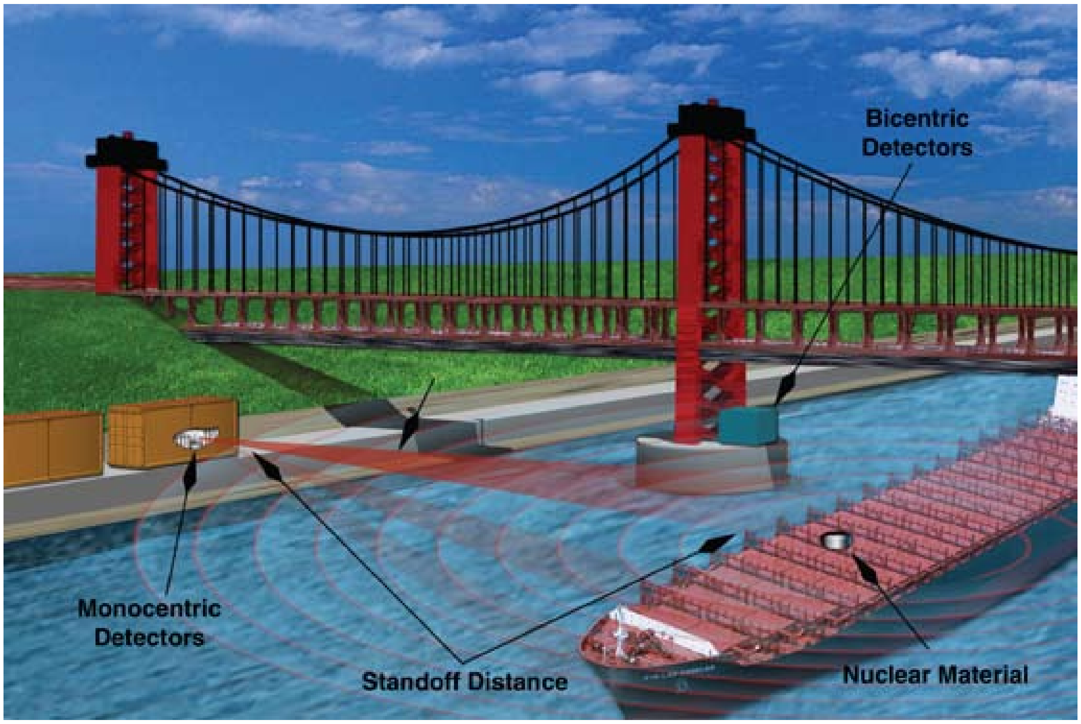
Finally, the targeting platform is a specially designed hydraulic lift and yaw mechanism which raises, lowers and directs the side-to-side motion of the PITAS system so that the energy beam remains on target for the desired time period. The platform relies on laser sighting to appropriately align the PITAS system with the cargo container.

Safety

The PITAS technology uses many of the same commercial components found in today's modern cancer treatment devices. Even though a number of safety features and processes are associated with operating the PITAS system, an object or individual walking through the inspection beam would receive about the same amount of radiation as someone taking several cross-country roundtrip flights.

PITAS Benefits

Because the device employs transportable technology, it



The PITAS technology allows cargo containers to be scanned for nuclear materials before ships dock at port.

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could be stationed at random locations along desired shipping routes or onboard military vessels in a point-and-shoot configuration.

Fort Pickett Demonstration

In association with the Defense Threat Reduction Agency (DTRA), INL scientists and base personnel from Fort Pickett near Blackstone, Va., will demonstrate the ability of the PITAS technology in September 2008. A series of tests is currently scheduled to determine if the PITAS technology can quickly and accurately detect shielded and unshielded nuclear material at a distance up to 200 meters.

Using Fort Pickett's Birchin Lake, three inspection configurations containing forms of nuclear material will be stationed afloat in the water channel. The PITAS technology will be stationed on the west side bank of the lake. Under strict environmental and safety guidelines, a short high-energy photon beam will be directed at each floating platform and used to positively confirm whether the inspected objects contain sample nuclear materials.

The PITAS system offers several advantages over competing technologies.

- Detects at distances up to 200 meters
- Operates remotely from command center
- Detects within seconds or minutes
- Offers nonintrusive, noncontact technology
- Uses high-energy 25-30 MeV accelerator
- Leaves no lasting impact or residue signature
- Controls dose on target with built-in collimator and accelerator operation
- Detects shielded materials
- Yields superior accuracy with pulsed operation and laser targeting
- Distinguishes between plutonium, uranium and thorium

The PITAS system was developed for the Defense Threat Reduction Agency by INL and Idaho State University engineers.

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In 2008, the PITAS system will be demonstrated at Fort Pickett's Birchen Lake.